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Body Composition Changes of Angus Females from Initial Breeding through Second Parturition and Weaning Determined by Real-time Ultrasound

G. H. Rouse
Iowa State University

D. E. Wilson
Iowa State University

Abebe Hassen
Iowa State University

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Body Composition Changes of Angus Females from Initial Breeding through Second Parturition and Weaning Determined by Real-time Ultrasound

A.S. Leaflet R1757

G. H. Rouse, professor,
D. E. Wilson, professor,
and Abebe Hassen, assistant scientist

Introduction

A new Iowa State University beef cattle breeding project was initiated in 1996 and is being conducted at the Rhodes and McNay Research and Demonstration Farms. The project will use the field data of the American Angus Association (AAA) along with the research resource cattle at the farms to study questions that will enhance genetic relationships between reproduction, production and carcass traits.

Initially Angus heifer calves were purchased from seedstock ranches in South Dakota and Nebraska. These heifers were developed and became part of the foundation herd of Quality and Retail Product lines. The objective of this study was to scan the heifers with real-time ultrasound as they developed from breeding time through second parturition and weaning to evaluate body composition changes.

Materials and Methods

- 255 spring-born Angus females were developed from initial breeding time through second parturition. Real-time ultrasound scans and weights were collected serially 5 times on the females:

  Scan times
  1. Before initial breeding (13-14 months of age)
  2. Before first calving (2 years of age)
  3. Weaning 1st calf
  4. Before 2nd calving (3 years of age)
  5. Weaning 2nd calf

- Ultrasound images were collected with a 500V ALOKA real-time ultrasound machine and an attached 3.5 MHZ, 17 cm linear array transducer. The images were stored digitally on a black box and interpreted at a later date in the Centralized Ultrasound Processing Laboratory

- Ultrasound measurements collected at the 12th - 13th rib included subcutaneous fat cover thickness, ribeye muscle area, and percent intramuscular fat. Table 1 compares percent intramuscular fat and marbling scores to put values into perspective relative to quality grade.

Table 1. Intramuscular fat, quality grade, degree of marbling and marbling score relationships.

Percent intramuscular fat	Quality grade	Marbling degree	Marbling score
2.3 - 3.0	Select -	Slight 0 - 40	4.0 - 4.4
3.1 - 3.9	Select +	Slight 50 - 90	4.5 - 4.9
4.0 - 5.7	Choice -	Small 0 - 90	5.0 - 5.9
5.8 - 7.6	Choice °	Modest 0 - 90	6.0 - 6.9
7.7 - 9.7	Choice +	Moderate 0 - 90	7.0 - 7.9
9.9 - 12.1	Prime -	Slightly Ab 0 - 90	8.0 - 8.9
12.3 -	Prime °	Moderately Ab 0 -	9.0 -

Results and Discussion

- Least squares means and standard errors for live weight, and live animal ultrasound measures including fat cover, percent intramuscular fat and ribeye area for each of the five serial scans are shown in Table 2.

- Figures 1-6 indicate the growth and body composition changes during the five serial scans.

- Heifers weighed 907 pounds initially at breeding time. Live weight (Figure 1) increased 102 lbs. from breeding until first calving. First calf heifers lost 84 lbs. during a 183 day lactation in a drier than normal season. These females then continued to gain weight linearly until their second calf was weaned when the cows were 1,331 days of age and weighed 1,263 lbs.

Table 2. Live weight and ultrasound measurements determined serially on the heifers.

	Fat Cover, in.	% Intramuscular fat	Weight, lbs. Wt.	Ribeye area, in^2
Measurement taken:				
Before Breeding	$0.08 \pm .08^{a,b}$	$4.95 \pm .91^{a,b}$	$907 \pm 68^{a,c}$	6.69 ± 1.03^{a}
Before 1st Calving	$0.16 \pm .03^{a,b}$	$5.13 \pm .34^{a,b}$	1009 ± 20^{b}	$8.02 \pm .38^{b}$
Weaning 1st Calf	$0.14 \pm .01^{a}$	$4.53 \pm .11^{a,b}$	925 ± 24^{a}	$9.20 \pm .13^{c}$
Before 2nd Calving	$0.24 \pm .03^{b}$	$4.11 \pm .35^{a}$	$1103 \pm 48^{b,c}$	$9.91 \pm .40^{d}$
Weaning 2nd Calf	$0.29 \pm .07^{b}$	$5.11 \pm .81^{b}$	1263 ± 100^{d}	$11.95 \pm .92^{c}$

Least squares means within a column with a different superscript are statistically significant (P<.05).

- Ultrasound subcutaneous fat measurements (Figure 2) increased from .08 to .29 from Scan 1 to Scan 5 in a pattern very similar to live weight.

- Percent intramuscular fat (Figure 3) changed one percent during the scanning period; however, the pattern of fat deposition was unique when compared with subcutaneous fat. Values continued to decline until females had their second calf.

- The intramuscular fat deposition pattern was examined in more detail in Figures 4 & 5. Figure 4 reflects 72 of the heifers that demonstrate a pattern similar to the means for all heifers except shifts in percent intramuscular fat are more pronounced, more than two percent. Figure 5 reflects 41 females that have a similar fat deposition pattern; however, the shifts in percent intramuscular fat are very small - less than one percent.

- Figure 6 relates linear growth of ribeye area, growth during the 905 day scanning period, suggesting that weight loss or energy repartitioning was never severe enough to restrict muscle growth.

- To help understand the relationship between subcutaneous fat and percent intramuscular fat deposition, heifers were divided into three frame categories based on adjusted yearling hip height (less than 5, 5-6 and greater than 6).

- Figure 7 relates the weights of the three frame categories. At first scan, the tallest heifers were 130 lbs. heavier than the shortest heifers and 92 lbs. heavier at the last scan when the second calf was weaned.

- Smaller framed heifers had less subcutaneous fat initially (however, differences were not-significant), and significantly (P<.01) more fat cover when the heifers calved the second time at three years of age (see Figure 8).

- Figure 9 indicates the small framed heifers had less (P<.05) intramuscular fat than large framed heifers initially, and this percent intramuscular fat difference still existed (P<.10) when the second calf was weaned.

Implications

- Real-time ultrasound can be used as a tool to evaluate body composition changes of live beef cattle as they grow and develop.

- The fat deposition pattern for subcutaneous and percent intramuscular fat were not the same. It took longer for percent intramuscular fat levels to recover from the stresses of first calving and lactation than it did for subcutaneous fat.

- A large percentage of the heifers demonstrated a very similar percent intramuscular fat deposition pattern;

however, the rate of change during the five serial scans varied markedly.

- Ribeye area growth during the scanning period suggests that weight loss or energy repartitioning was never severe enough to restrict muscle growth.

Summary

Growth and body composition changes on 255 spring-born Augus heifers was measured five times with real-time ultrasound from initial breeding through second parturition and weaning. Heifers weighed 907 pounds initially, lost 84 pounds during their first calving and lactation, then continued to gain weight and weighed 1,263 pounds when their second calf was weaned. Ribeye area and measure of growth continued to grow in a linear pattern during the total time frame suggesting that weight loss or energy repartitioning was never severe enough to restrict muscle growth. The fat deposition pattern for subcutaneous and intramuscular fat were not the same. Fat cover followed a pattern very similar to changes in weight, although it took longer for intramuscular fat levels to recover from the stresses of first calving and lactation.

Figure 1. Heifer weights.

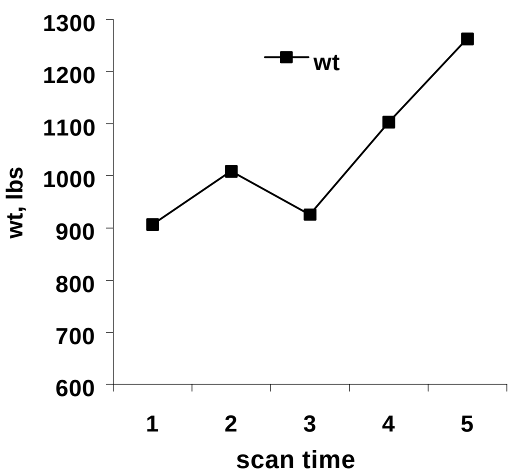

Figure 2. Subcutaneous fat measurements.

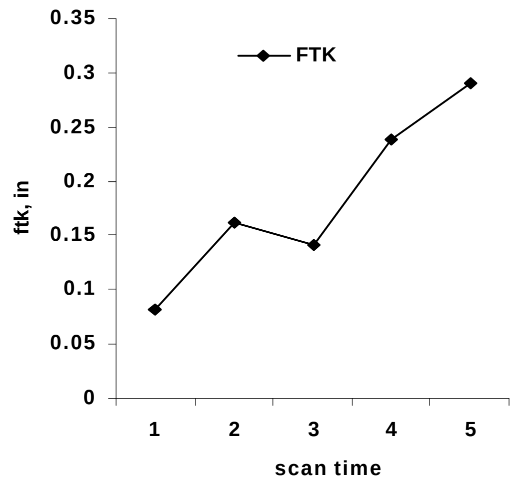

Figure 3. % intramuscular fat measurements.

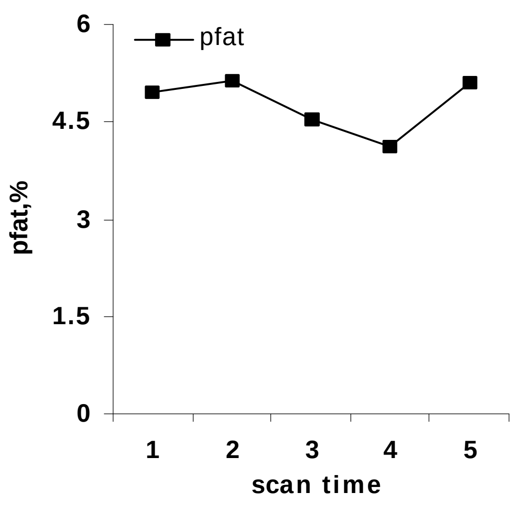

Figure 4. % intramuscular fat measurements of 72 heifers.

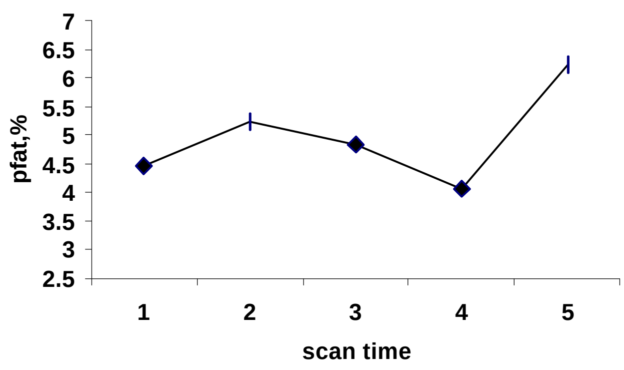

Figure 5. % intramuscular fat measurements of 41 heifers.

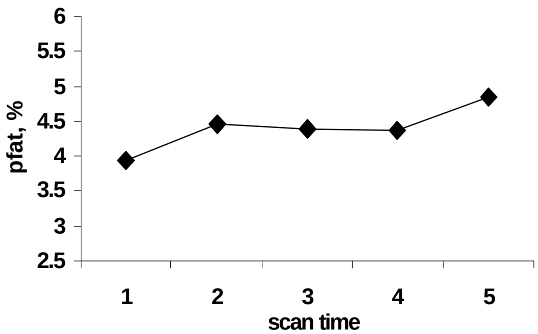

Figure 6. Ribeye area measurements.

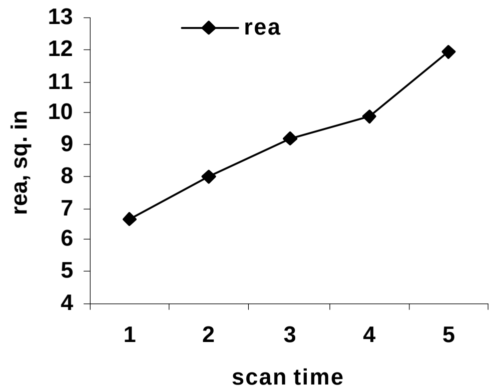

Figure 7. Heifer weights for three frame sizes of heifers.

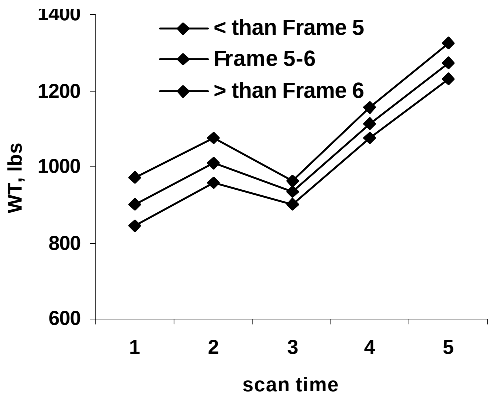

Figure 8. Subcutaneous fat measurements for three frame sizes of heifers.

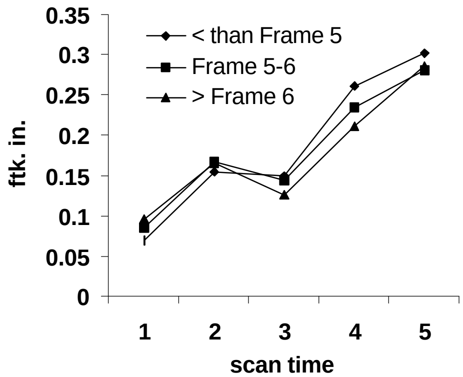

Figure 9. % Intramuscular fat measurements for three frame sizes of heifers.